

ECOSYSTEM STATUS INDICATORS***Habitat*****Effects of Fishing Gear on Seafloor Habitat**

Edited by Jonathan Heifetz (Alaska Fisheries Science Center, Auke Bay Laboratory)

Last updated: November 2005

In 1996, the Alaska Fisheries Science Center (AFSC) initiated a number of seafloor habitat studies directed at investigating the effects of fishing on seafloor habitat (Table 7). Each year a progress report for each of the projects is completed. Scientists primarily from the Auke Bay Laboratory (ABL) and the Resource Assessment and Conservation Engineering (RACE) Divisions of the AFSC have been conducting this work. Some of those studies are summarized in Appendix 1 along with studies of Essential Fish Habitat: Essential Fish Habitat Research by AFSC, and Effects of Fishing Gear on Seafloor Habitat – Progress Report for FY2004.

A web page <http://www.afsc.noaa.gov/abl/MarFish/geareffects.htm> has been developed that highlights these research efforts. Included in this web page are a research plan, previous progress reports, and a searchable bibliography on the effects of mobile fishing gear on benthic habitats. A list of recent publications follows Table 7.

Table 7. A list of habitat research projects, scientists, and contact information.

Project Title	Project Description	Location	Species Investigated	Habitat Investigated	Application to Management	Field/Lab Study	Contact
Submersible evaluation of eastern GOA corals	Determine distribution of <i>Primnoa</i> coral at pending and potential HAPC sites and study coral habitat ecology.	Eastern Gulf of Alaska	Corals, sponges, associated FMP species	Hard-bottom coral	HAPC delineation, defining EFH, evaluation of gear impacts	Field	Bob Stone (ABL)
Trawl sweep and footrope modifications to reduce seafloor effects	Investigation into the development of trawl gear to reduce the impacts of trawling on the seafloor	Bering Sea	Bering Sea flatfish & pollock and benthic invertebrates	Soft-bottom shelf	Reducing gear impacts	Field	Craig Rose (RACE)
Interannual and habitat-specific growth rates of northern rock sole	Importance of local habitat and regional oceanographic conditions on growth and survival	Northern Gulf of Alaska	Northern rock sole	Soft-bottom shelf	Defining EFH	Field	Hurst (RACE)
Atka mackerel spawning and nesting in the Aleutians	Investigation of Atka mackerel spawning habitat/nesting and spawning behavior through use of video, diving, and time lapse photography.	Aleutian Islands	Atka mackerel	Hard-bottom	Defining EFH	Field	Bob Lauth (RACE)
Effects of experimental bottom trawling on soft-sediment sea whip habitat in the Gulf of Alaska	Determine immediate effects of bottom trawling on soft-sediment areas colonized by sea whips.	Kodiak	Sea whips and associated FMP species	Soft-bottom shelf	Gear impacts	Field	Bob Stone (ABL)
Sea whip resiliency to simulated trawl disturbance	Determine recovery of sea whips damaged by fishing gear	Southeast Alaska	Sea whips	Soft-bottom shelf	Gear impacts	Field and Lab	Pat Malecha (ABL)
Growth and recruitment of an Alaska shallow-water gorgonian coral	Assess growth and recruitment of <i>Calcigorgia spiculifera</i> , a habitat forming gorgonian coral.	Southeast Alaska	Gorgonian coral and associated FMP species	Hard-bottom coral	Gear impacts, mitigation.	Field	Bob Stone (ABL)
Video analysis of flatfish nursery habitat and gear impacts	Multivariate analysis of habitat utilization	Northern Gulf of Alaska	Flatfish	Soft-bottom shelf	Defining EFH	Field	Al Stoner (RACE)

Project Title	Project Description	Location	Species Investigated	Habitat Investigated	Application to Management	Field/Lab Study	Contact
Juvenile rockfish habitat associations	Examination of the abundance and habitat use of juvenile rockfish relative to small scale habitat features and multibeam/backscatter derived habitat type maps.	Southeast Alaska, Albatross Bank, Gulf of Alaska	Rockfish	Comprehensive - mostly offshore	Defining EFH	Field	Jon Heifetz and Kalei Shotwell (ABL)
Groundfish habitat associations	Examination of the abundance and habitat use of groundfish in fished areas relative to multibeam/backscatter derived habitat type maps.	Albatross Bank, Gulf of Alaska, Southeast Alaska	FMP species	Offshore banks	Defining EFH	Field	Jon Heifetz and Kalei Shotwell (ABL)
Aleutian Island corals and sponges	Coral and sponge ecology, taxonomy, and habitat distribution. Predictive model to determine extent of coral habitat.	Aleutian Islands	Corals, sponges, and associated FMP species	All habitats	Defining EFH, evaluation of gear impacts	Field	Bob Stone and Jon Heifetz (ABL)
Habitat Impacts Model	Model enables quantitative evaluation of mitigation strategies and the effects of fishing on benthic habitat.	Alaska EEZ	Comprehensive	Comprehensive	Comprehensive evaluation of gear impacts and mitigation measures	Lab	Jeff Fujioka (ABL)
Emergent structure in low-relief benthic habitats as criteria for defining EFH	Evaluate role of habitat structural complexity for flatfishes	Northern Gulf of Alaska	Flatfishes	Soft-bottom shelf	Test gear impacts and define EFH	Field & Lab	Cliff Ryer (RACE)
Defining EFH for Juvenile Flatfishes	Spatially explicit analysis of habitat utilization	Northern Gulf of Alaska	Flatfish	Soft-bottom shelf	Defining EFH	Field & Lab	Al Stoner (RACE)
Juvenile Lingcod EFH	Experimental evaluation of habitat utilization	NW & Alaska	Lingcod	Nearshore	Defining EFH	Field & Lab	Cliff Ryer (RACE)
Determining the value of habitat to juvenile rockfish in the Aleutian Islands	Mapping rockfish habitat and estimation of juvenile POP condition in study areas around the Islands of Four Mountains	Aleutian Islands	HAPC species and Pacific ocean perch	Hard and soft bottom offshore	Define EFH	Field	Chris Rooper (RACE)
Bogoslof Island mapping and colonization	Map island slopes (completed) and conduct ROV video census surveys of areas of different age eruptions	Bogoslof Island, southern Bering Sea	Long-lived sponge and corals	Hard-bottom	Determine proxy for hard-bottom sessile invert. recovery from bottom contact fishing gear.	Field	Mark Zimmermann (RACE)

Project Title	Project Description	Location	Species Investigated	Habitat Investigated	Application to Management	Field/Lab Study	Contact
Sediment database-usseabed	Combine historic sediment data in a database to define habitat	North Pacific	Habitat	All types	Help define seafloor habitat types	Lab	Mark Zimmerman (RACE)
Trawl database	Locate and enter historic trawl data to define habitat	North Pacific	Habitat	All types	Help define seafloor habitat types	Lab	Mark Zimmerman (RACE)
Groundfish habitat characterization	Develop statistical models to explain groundfish distribution and abundance.	Eastern Bering Sea	Most groundfish & benthic invertebrates	Offshore; soft-bottom shelf	Define EFH	Lab	RACE Habitat Research Team
Acoustic seabed mapping	Evaluate acoustical tools for characterizing seabed properties affecting the distribution and abundance of groundfish/benthic invertebrates. Develop processing methods for producing standardized quantitative measurements (data). Use statistical methods to compare costs and benefits of the various instruments and processing methods.	Eastern Bering Sea	Most groundfish & benthic invertebrates	Offshore; soft-bottom shelf	Define EFH and support effects of fishing investigations.	Both	RACE Habitat Research Team
Spatial and temporal patterns in Bering Sea invertebrates	Define distinct benthic communities as basis for systematic study of fishing gear effects on EFH.	Eastern Bering Sea	Epifauna and some infauna taken in RACE bottom trawl surveys.	Offshore; soft-bottom shelf	Define EFH and study effects of fishing gear on EFH.	Both	RACE Habitat Research Team
Bottom trawl effects on soft-bottom habitat	Quantify bottom trawl effects on soft-bottom habitat in naturally disturbed areas. Use experimental methods to study both long-term (chronic) and short-term (acute) disturbances, as well as recovery.	Eastern Bering Sea	Most groundfish & benthic invertebrates	Offshore; soft-bottom shelf	Effects of Fishing on EFH	Field	RACE Habitat Research Team

Project Title	Project Description	Location	Species Investigated	Habitat Investigated	Application to Management	Field/Lab Study	Contact
Identification of skate nursery areas in Bering Sea	The project will look at habitat use spatially and temporally and species and benthic associations to help characterize skate nurseries.	Eastern Bering Sea	Two species of skates, Alaska Skate <i>Bathyraja parmifera</i> and the Aleutian Skate <i>Bathyraja aleutica</i>	Offshore; soft-bottom shelf	Define EFH	Field	Jerry Hoff (RACE)
Statewide monitoring and mapping	Shorezone mapping coupled with fish assessments	Southeast Alaska in FY05, Prince William Sound in FY06, and other areas in future years	Plant and fish communities including juvenile FMP species	Nearshore	Define EFH	Field	Jeep Rice and Scott Johnson (ABL)
Berners Bay monitoring and mapping	Evaluate impacts of mine development	Berners Bay, southeast Alaska	Plant and fish communities including juvenile FMP species	Nearshore	Evaluate mining development impacts	Field	Jeep Rice and Pat Harris (ABL)
Juneau Borough monitoring and mapping	Evaluate impacts of urban development	Juneau Borough, southeast Alaska	Plant and fish communities including juvenile FMP species	Nearshore	Evaluate urban development impacts	Field	Jeep Rice and Pat Harris (ABL)
Aleutian Islands monitoring and mapping	Define fish use in the Aleutian nearshore	Aleutian Islands	Plant and fish communities including juvenile FMP species	Nearshore	Define EFH	Field	Jeep Rice and Scott Johnson (ABL)
Beaufort Sea monitoring and mapping	Evaluate impacts of gravel extraction and shore erosion	Beaufort Sea	Plant and fish communities including juvenile FMP species	Nearshore	Evaluate impacts of gravel extraction to rebuild eroded beaches	Field	Jeep Rice and Scott Johnson (ABL)

Project Title	Project Description	Location	Species Investigated	Habitat Investigated	Application to Management	Field/Lab Study	Contact
Shorezone and Atlas	Combine shorezone mapping with fish utilization assessments	Southeast Alaska in FY06 and other areas in future years	Plant and fish communities including juvenile FMP species	Nearshore	Compendium of biotic and habitat information to assess potential development impacts, quantify habitat types, and monitor climate change effects	Lab	Jeep Rice (ABL)
Southeast Alaska Estuarine Habitat Survey	Describe estuarine fish habitat and estimate fish abundance by habitat type	Southeast Alaska	Substrate, plant and fish communities including juvenile FMP species	Estuaries	Define EFH and provide baseline information for habitat assessments	Field	Mitch Lorenz (ABL)

AFSC publications on benthic habitat and the effects of fishing

- Andrews, A.H., E.E. Cordes, M.M. Mahoney, K. Munk, K.H. Coal, G.M. Calliet, and J. Heifetz. 2002. Age, growth, and radiometric age validation of a deep-sea, habitat-forming gorgonian (*Primnoa resedaeformis*) from the Gulf of Alaska. *Hydrobiologia* 471: 101-110.
- Bornhold, B.D., C.V. Jay, R.A. McConnaughey, G. Rathwell, K. Rhynas and W. Collins. 2004. Walrus foraging marks on the seafloor in Bristol Bay, Alaska – a reconnaissance survey. *Geo-Marine Letters* (in press).
- Dew, C.B and R.A. McConnaughey. 2005. Did bottom trawling in Bristol Bay's red king crab brood-stock refuge contribute to the collapse of Alaska's most valuable fishery? *Ecological Applications* 15: 919-941.
- Dieter, B.E., Wion, D.A. and R.A. McConnaughey (editors). 2003. Mobile fishing gear effects on benthic habitats: a bibliography (second edition). U.S. Dep. Commer., NOAA Tech. Memo.NMFS-AFSC-135, 206 p.
- Freese, L., P. J. Auster, J. Heifetz and B. L. Wing. 1999. Effects of trawling on seafloor habitat and associated invertebrate taxa in the Gulf of Alaska. *Mar. Ecol. Prog. Ser.* 182:119-126.
- Freese, L. 2001. Trawl-induced damage to sponges observed from a research submersible. *Mar. Fish. Rev.* 63(3): 7-13.
- Freese, J.L. and B.L. Wing. 2004. Juvenile red rockfish, *Sebastes* sp., associations with sponges in the Gulf of Alaska. *Mar. Fish. Rev.* (in press).
- Fujioka, J.T. 2004. A habitat impact model for evaluating fishing impacts on habitat and fishing closure strategies. (in review).
- Heifetz, J. (ed.) 1997. Workshop on the potential effects of fishing gear on benthic habitat. NMFS AFSC Processed Report 97-04. 17 pp.
- Heifetz, J. 2002. Coral in Alaska: distribution abundance, and species associations. *Hydrobiologia* 471: 19-28.
- Heifetz, J., R. P. Stone, P. W. Malecha, D. L. Courtney, J.T. Fujioka, and P.W. Rigby. 2003. Research at the Auke Bay Laboratory on Benthic Habitat. AFSC Quarterly Report Feature (July-August-September 2003). 10 p.
- Heifetz J, B.L. Wing, R.P. Stone, P.W. Malecha, and D.L. Courtney. 2005. Corals of the Aleutian Islands. *Fisheries Oceanography* 14(s1):131-138.
- Hurst, T.P. and A.A. Abookire. 2005. Temporal and spatial variation in potential and realized growth rates of age-0 northern rock sole. *J. Fish Biol.* (in review)
- Krieger, K. J. and B. Wing. 2002. Megafauna associations with deepwater corals (*Primnoa* spp.) in the Gulf of Alaska. *Hydrobiologia* 471: 83-90.
- Krieger, K. 2001. Coral (*Primnoa*) impacted by fishing gear in the Gulf of Alaska. In J.H. Martin Willison et al. (eds.) *Proceedings of the First International Symposium on Deep-Sea Corals, Ecology Action Center and Nova Scotia Museum, Halifax, Nova Scotia Canada.*
- Lehnert H., R. Stone, and W. Heimler. 2005. A new species of *Polymastia* (Porifera, Hadromerida, Polymastiidae) from the Aleutian Islands. *Facies*: (in press).
- Lehnert H., R. Stone R., and W. Heimler. 2005. Two new species of *Plakina* Schulze, 1880 (Porifera, Plakinidae) from the Aleutian Islands (Alaska, USA). *Zootaxa* 1068: 27-38.
- Lehnert H., L. Watling, and R. Stone. (in press). *Cladorhiza corona* sp. n. (Porifera, Demospongiae, Cladorhizidae) from the Aleutian Islands. *Journal of the Marine Biological Association of the United Kingdom.*
- Malecha, P., R. Stone, and J. Heifetz. 2005. Living substrates in Alaska: distribution, abundance and species associations. Pages 289-299 in P. W. Barnes and J. P. Thomas, editors. *Benthic habitats and the effects of fishing.* American Fisheries Society, Symposium 41, Bethesda, Maryland.
- Malecha, P. and R. Stone. 2004. Sea whip (Order Pennatulacea) resiliency to simulated trawl disturbance. (in review).

- Marlow, M.S., A.J. Stevenson, H. Chezar and R.A. McConnaughey. 1999. Tidally-generated seafloor lineations in Bristol Bay, Alaska. *Geo-Marine Letters* 19: 219-226.
- Masuda M. M., and R. P. Stone. 2003. Biological and spatial characteristics of the weathervane scallop *Patinopecten caurinus* at Chiniak Gully in the central Gulf of Alaska. *Alaska Fishery Research Bulletin* 10(2): 104-118.
- McConnaughey, R.A., K. Mier and C.B. Dew. 2000. An examination of chronic trawling effects on soft-bottom benthos of the eastern Bering Sea. *ICES J. Mar. Sci.* 57: 1377-1388.
- McConnaughey, R.A. and K.R. Smith. 2000. Associations between flatfish abundance and surficial sediments in the eastern Bering Sea. *Can. J. Fish. Aquat. Sci.* 57: 2410-2419.
- McConnaughey, R.A., S.E. Syrjala and C.B. Dew. 2005. Effects of chronic bottom trawling on the size structure of soft-bottom benthic invertebrates. Pages 425-438 in P. W. Barnes and J. P. Thomas, editors. *Benthic habitats and the effects of fishing*. American Fisheries Society, Symposium 41, Bethesda, Maryland.
- Preston, J.M., A.C. Christney, W.T. Collins, R.A. McConnaughey and S.E. Syrjala. 2004. Considerations in large-scale acoustic seabed characterization for mapping benthic habitats. *ICES CM* 2004/T:13, 8 p.
- Rooper, C. N., M. Zimmermann and P. Spencer. 2005. Distribution of flathead sole (*Hippoglossoides elassodon*) by habitat in the eastern Bering Sea. *Marine Ecology Progress Series* 290:251-262.
- Rooper, C. N. and J. L. Boldt. 2005. Distribution and abundance of juvenile rockfish in the Aleutian Islands. *Alaska Fishery Research Bulletin* 11 (in press).
- Ryer, C.H., A.W. Stoner and R.H. Titgen. 2004. Behavioral mechanisms underlying the refuge value of benthic habitat structure: two flatfishes with differing anti-predator strategies. *Mar. Ecol. Prog. Ser.* 268:231-243.
- Shotwell, S. K., J. Heifetz, D.L. Courtney, and H.G. Greene. 2005. Mapping marine benthic habitat in the Gulf of Alaska: geological habitat, fish assemblages, and fishing intensity. Pages xxx-xxx. in B. Todd and H.G. Greene (editors) *Geological Association of Canada Special Paper* 44. (in press).
- Smith, K.R. and R.A. McConnaughey. 1999. Surficial sediments of the eastern Bering Sea continental shelf: EBSSSED database documentation. U.S. Dep. Commer., NAA Tech. Memo. NMFS-AFSC-104. 41 p.
- Spencer, M.L., A.W. Stoner, C.H. Ryer and J.E. Munk. 2005. Use of a towed camera sled for estimating abundance and habitat characteristics of juvenile flatfishes: comparison with beam trawl and diver transects. *Estuar. Coastal Shelf Sci.* 64:497-503.
- Stone, R.P., and B.L. Wing. 2001. Growth and recruitment of an Alaskan shallow-water gorgonian. Pages 88-94 in J. H. Martin Willison et al. (eds.). *Proceedings of the First International Symposium on Deep-Sea Corals*, Ecology Action Centre and Nova Scotia Museum, Halifax, Nova Scotia.
- Stone, R. P., and M. M. Masuda. 2003. Characteristics of benthic sediments from areas open and closed to bottom trawling in the Gulf of Alaska. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-140.
- Stone, R. P., M. M. Masuda, and P. W. Malecha. 2005. Effects of bottom trawling on soft-sediment epibenthic communities in the Gulf of Alaska. Pages 461-475 in P. W. Barnes and J. P. Thomas, editors. *Benthic habitats and the effects of fishing*. American Fisheries Society, Symposium 41, Bethesda, Maryland.
- Stone, R. P. 2005. Exploring deep-sea corals on the edge - Alaska's Aleutian Islands. *Current - The Journal of Marine Education* 21 (4): 18-21.
- Stoner, A.W. and R.H. Titgen. 2003. Biological structures and bottom type influence habitat choices made by Alaska flatfishes. *J. Exp. Mar. Biol. Ecol.* 292:43-59.
- Stoner, A.W. and A.A. Abookire. 2002. Sediment preferences and size-specific distribution of young-of-the-year Pacific halibut in an Alaska nursery. *J. Fish Biol.* 61:540-559.
- Stoner, A.W. and M.L. Ottmar. 2003. Relationships between size-specific sediment preferences and burial capabilities in juveniles of two Alaska flatfishes. *J. Exp. Mar. Biol. Ecol.* 282:85-101.

- Stoner, A.W., M.L. Spencer and C.H. Ryer. 2005. Flatfish-habitat associations in Alaska nursery grounds: use of continuous video records for multi-scale spatial analysis. *J. Sea Res.* (in review)
- Syrjala, S.E. 200 . Designing experiments: using the statistical bootstrap to calculate sample size. *Ecology* (in review).
- von Szalay, P.G. and R.A. McConnaughey. 2002. The effect of slope and vessel speed on the performance of a single beam acoustic seabed classification system. *Fish. Res. (Amst.)* 56: 99-112.
- Wion, D.A. and R.A. McConnaughey. 2000. Mobile fishing gear effects on benthic habitats: a bibliography. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-116. 163 p.
- Wing, B.L. and D.R. Barnard. 2004. A field guide to Alaska corals. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-146, 67 p.
- Yeung, C. and R.A. McConnaughey. 2005. The community structure of the eastern Bering Sea epibenthic invertebrates from annual summer bottom trawl surveys, 1982-2002. *Mar. Ecol. Prog. Ser.* (in review).